THE PRESENT STATUS AND REAL MEANING OF GENERAL SCIENCE

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One characteristic marks off the nineteenth century from all preceding centuries in the world's history. That characteristic is the achievements of science and man's mastery over the forces of nature. The nineteenth century opened with such means of transportation and communication only as were enjoyed by Abraham when he journeyed into the land of Canaan. Under such conditions man perforce through all the centuries of his existence had led an isolated life. Within one century time and space have been all but eliminated and the whole civilized world has become a single social unit.

A second phase of the achievements of science was the recasting of all the activities of daily life. The achievements of science during the last century completely revolutionized the home, the school and its surroundings, every phase of country, town, and city life, all methods of heating and lighting, ventilation, and sanitation, of obtaining food and clothing—in fact, they revolutionized all activities of modern life. To fit into this modern world anywhere understandingly, some knowledge of the living world and the physical forces about us is a necessity. The social significance of science in modern life gives it ever-increasing importance as a subject in our public-school curriculum.

Again, the content of our knowledge concerning the natural world and physical forces is increasing with a rapidity and a certainty almost beyond the comprehension of the human mind. For convenience, the mature scientist, viewing this new world of knowledge philosophically, divides it into many so-called special sciences, and the mature student aspiring to do research work and make some contribution to our fund of knowledge necessarily

confines his study to some small portion of a *single* science. Moreover, he can hope to succeed only by acquiring the technique of the specialist.

The great mass of humanity, however, those engaged in the world's work, laboring in the humbler walks of life, in production, as in agriculture, horticulture, gardening, stock-raising, or in mining, or in the manufacturing industries, or in trade and commerce, or even in many of the professions—these people have slight need of such special training and technique. They need instead an insight into the broad general principles of science and above all they need to see clearly and to comprehend the significance of science as it spins and weaves the social fabric of modern civilization.

SCIENCE MUST BE DISSEMINATED

To neglect the training of research workers in the field of science would be fatal to further progress in man's control of Nature and her forces. It would mean stagnation in material progress and that must ever mean stagnation in mental, moral, and spiritual progress. But, on the other hand, to neglect the interpretation and dissemination of scientific knowledge and the training of the masses of common people in scientific thinking is to rob humanity, in a large measure, of the fruits of scientific research. It is to the interest of all humanity that even the humblest laborer, toiling with pick and shovel, shall have some knowledge of the laws of science as related to his labor and his living. Modern civilization and all that is most significant to the common people in the way of improved living conditions, of more efficient labor, of shorter hours of labor, and of greater facilities for recreation and pleasure, depend largely and primarily upon, first, the achievements of the research worker in revealing the truths of science, and second, the dissemination of those truths among the common people and the training of the masses in thinking scientifically.

We are confronted today with no danger of neglecting the training of research workers in the field of science. Every great university in the land is chiefly engaged in this work. The ablest men in their science departments are spending their energies largely in training research workers in their graduate departments. The

undergraduate departments of these universities and most of our colleges are largely engaged in preparing students to enter these graduate schools, while the science courses in our high schools are, in the main, shaped and determined by college-entrance requirements. Our high schools are vestibules to the college; our colleges are vestibules to the graduate school of the university. From top to bottom and from bottom to top the science work in our educational institutions is chiefly shaped and planned to furnish a direct path for the training of research workers. It is necessary that such a path be provided; but, we must not lose sight of the fact that it is equally necessary that the needs of the masses of young people, preparing, not for research work, but for the ordinary activities of life, receive some consideration. Science falls far short of fulfilling its mission unless the fruits of scientific research fall upon fertile soil and take root in the daily-life activities of the masses.

Are our educational institutions preparing the masses to appreciate and utilize the products of research work in science? This can be done directly and efficiently only through science instruction in our public schools, where the masses of young people should learn to interpret and to understand the significance of science as it affects their life-work—to think scientifically as they work. They need *less* the scientific thinking of *meditation;* they need *most* the scientific thinking of *participation* in the fundamental activities of modern life. And where are our great educational institutions which stand out conspicuously for their efforts and accomplishments in the training of science teachers for our public schools? Where are our great universities which emphasize the art of interpreting and disseminating the fruits of scientific research as they emphasize the art of research itself?

In commenting upon the tendencies in our high schools the Commissioner of Education in his report, 1911, reviewing the educational progress of the decade, says: "Latin is holding its ground; French and German are gaining; algebra occupies a large share of time and is steady; geometry is gaining; English and history have gained materially; all the older sciences, rather strangely, are relatively falling off."

At last we are waking up to the situation. We are beginning to realize that something is wrong—radically wrong—with our public-school work in science. What is the trouble? Have you diagnosed the case? Have you a remedy to suggest?

OVERSPECIALIZATION

Some of us are convinced that the malady from which the public-school science is suffering is directly traceable to an overdose of specialization. The needs of the research specialist are dominating and determining largely the college courses in science; college-entrance requirements almost completely determine the character of our high-school courses in science. We have built our science courses from the top downward. We have attempted to start every fourteen-year old boy and girl entering the high school upon the path laid out for the benefit of the exceptional boy or girl who may become a research worker in the university. We have presumed that every fourteen-year-old youth is eager and ready to think in abstract terms. We have attempted to feed him on abstract principles and generalizations, never pausing to inquire about his likes and dislikes or to study the fundamental characteristics of the adolescent mind. We have failed to note that boys and girls of fourteen are chiefly interested in learning things for the sake of knowing those particular things. The adolescent is not yet a philosopher. Abstractions, generalizations, and type-studies are foreign and distasteful to the normal adolescent mind. Youth is ambitious, but it ever seeks the short cut. Necessity also plants its iron heel firmly down upon the ambition of the youth from the toiling classes. The wail and clamor from hungry mouths, the pleadings for the necessities of life are ever ringing in his ear, and in the ear of his parents. If he enters the high school at all it is generally for the purpose of spending one or two years, possibly three or four years, in better preparing himself for life's work—for the struggle of earning a living. The boys and girls from the laboring classes, indeed, from the masses of the common people everywhere, as well as their parents, have a right to demand that they be shown the worth-whileness of the tasks set before them. Can our high-school principals and science teachers do this successfully

while following the usual courses in special science shaped and planned chiefly for a different purpose?

PRESENT STATUS OF GENERAL SCIENCE

At the request of the chairman of the science section of the National Education Association I undertook last summer to discover the status of what is known as general science. I endeavored to ascertain where and in how many high schools courses called general science were being taught, and later to obtain from the principals of some of those schools information as to what they were attempting to do and with what measure of success their efforts were meeting.

About June 1, 1914, a questionnaire was sent to 180 schools which are among those reported as offering a course called general science. With few exceptions these were addressed to the principals. Up to June 25, replies from 73 schools had been received. All the questions asked were framed with the idea of stimulating thought rather than obtaining ease of tabulation. Some of the replies were consequently rather difficult to tabulate, but it is the belief of the writer that a truer expression of ideas was obtained. A copy of the questionnaire with a summary of the replies is appended to this paper.

A complete analysis of this report is unnecessary. Facts, if correctly reported, are facts, and therefore undebatable. They are, nevertheless, of the greatest value since they furnish the only reliable basis for opinion. I shall call attention to but two items under the questions of fact. First, in replying to the second question, regarding the length of the course given, it will be noted that but one school reports a course in general science more than one year in length. I predict with confidence that a similar investigation ten years hence, possibly five years hence, will reveal many schools offering general science courses at least two years in length. Second, in reply to the sixth question, regarding texts used, it will be noted that eleven different texts were used in giving these so-called general science courses. To one at all familiar with the science texts available during the school year of 1913–14 the answer to this question, together with the answers to the tenth question in

the second list, indicates that up to that date, at least, no generally satisfactory texts had made their appearance. I am also convinced that for some years to come, at least until there is available a supply of teachers especially trained to teach general science, textbooks presenting well-organized courses will be as necessary in general science as they are in special science or in any other subject offered in our high schools. The greatest need today, one felt keenly by every science teacher who has become convinced that our science teaching has become too highly specialized, is for organized courses in general science. Furthermore, however true it may be that the best science teaching, at least in the first high-school year, is merely the teaching of the science of the pupil's environment, it is asking the impossible when we ask each teacher to organize such material and put it in teachable and available form.

Passing to the questions of opinion: Opinions are always debatable but the answers to the first and second questions indicate clearly, to my mind, that thus far the experiments with so-called general science have very generally met with the approval of the principals of the schools in which they have been tried. It was most interesting to me to discover that the only person answering the first question in the negative answered the second question in the affirmative.

In my judgment the most significant question in the entire set was the sixth in the second list: "Should the units of instruction in general science differ materially from those in special science?" And yet there were fewer answers to this question than to any other. The term "units of instruction" seems not to have been understood by many. From the replies one is warranted in concluding that many of the respondents have no clearly formulated ideas regarding the real nature and real significance of the general-science movement. Science organized and developed into units of instruction not materially differing from the units of instruction in special science can be nothing other than special science. To attempt to organize science material without recognizing the fundamental difference in the organization of special science and general science is certain to result, it seems to me, in a mere collection of loosely related principles picked from the various special

sciences. Those principles may be the most interesting and striking principles of the special sciences and yet such a course might easily have considerably less significance as educative material than any course in special science. In my judgment most of the so-called general science being offered today is merely fragmentary special science and of exceedingly doubtful educational value.

General science as conceived by its leading advocates is quite as much a different mode of organization and a different mode of attack as it is a new and different selection of material. Much of the material which has thus far appeared in texts called general science consists of clippings from the special sciences. To a less extent the same is true of the half-dozen unpublished outlines which I have received. In many cases little or no unifying idea, giving the unit of instruction significance and educational value, is evident. In my judgment, the advocates of special science, with justified reverence for logical thinking, and training in scientific thinking, may well call such a course "hodgepodge" and dub it "a spineless wonder."

If general science is to be of educational value, it must consist of well-organized units of instruction. These units must be as definite and as well organized as are the units of special science. They will differ, however, from the units of special science in the fact that they are fundamentally units of practical science or applied science instead of units of theoretical science. The core of the unit in general science will be some process or some device utilized by the individual or by society in the ordinary activities of modern life. To illustrate: In the special science physics, under "Light," we find such units as these: "Light, Its Rectilinear Propagation; Shadows; Photometry and the Law of Reflection; Mirrors and the Formation of Images; Refraction of Light; The Formation of Images by Lenses; Optical Instruments; Color and Spectra; Nature of Light; Interference and Polarization." In marked contrast, general science adapted to the ninth grade will be developed through units of instruction somewhat of the following character: "Primitive Lamps; Candles; How the Candle Burns; Discovery of Petroleum; Kerosene Lamps; How Kerosene Burns; Evaporation,

Boiling-Point and Distillation; Crude Petroleum; Distillation of Petroleum; Gasoline; Why Gasoline Is Dangerous; Inspection of Oils; Cautions in Using Kerosene and Gasoline; Gasoline Lamps; Gasoline Gas; Illuminating Gas; Distillation of Coal; Coal Gas; Water Gas; Acetylene Generators; Acetylene Lighting; Electric Lights and Electric Lighting; Natural Lighting of Rooms; Direct and Diffused Light; Importance of Diffused Light; Intensity of Light Required; Cost of Artificial Lighting."

A course in general science, properly conceived, has unity and logical development. It has educational value of the highest order. It is adapted to the adolescent mind and at the same time appeals to the pupil as worth while. It trains in scientific thinking and deals with material with which the pupil is already somewhat familiar. It starts with the known and proceeds to the related unknown. It deals only with the concrete because the significant is always concrete. It gives the pupil control of his environment and an appreciation of the significance of science in modern life. Such a course in science study is *general* because it disregards the artificial boundaries of special science. To study tallow or paraffin candles, the material of which they are made, how they are made, how they burn, and their significance in the development of civilization, involves material from several different special sciences. The units of applied science are never drawn from the field of a single special science. The science involved in raising corn on the fertile plains of Illinois involves some knowledge of the character of the soil itself, geology, some knowledge of the structure and composition of the soil, soil physics and soil chemistry, some knowledge of plant life and plant growth, botany, some knowledge of the weather and climate, meteorology, and some knowledge of insect life, zoölogy. Why do we insist that the pupil be eternally separating these elements of nature—these items of his natural environment—which the Creator has so marvelously and wondrously fitted together into a perfect whole? Why do we insist that he forever and eternally be separating them from their natural, logical, and necessary relationships and placing them in the man-made category of special science? Is there less education, less mental training, less scientific thinking, or less culture in seeing and comprehending

the units of nature as designed by the Creator than by seeing and comprehending the units designed by man?

THE PLEA FOR SPECIAL SCIENCE

Occasionally we hear an advocate of special science in the high school presenting his case. While admitting that science instruction in the high school may, at this time, very justly have been called to the bar of public opinion, he still insists that science instruction is improving daily, that the rank and file of science teachers will soon be so prepared that they can present special science in an interesting and profitable manner. He closes his argument with the statement that to substitute general science for special science in the early years of the high school at this time would completely upset the entire course in science, set science in the high school back a generation, and inevitably mean a great and deplorable loss for the cause of education.

I never hear such an argument without recalling another case which is recorded in that delightfully written volume *The Biography of Thomas Wentworth Higginson*, by Mary Thacher Higginson. Not long after the close of the Civil War a very attractive young woman appealed to Mr. Higginson to attempt to secure a pension for her on the grounds that she was the daughter of a certain man, that he was a Union soldier, and that he died of starvation and exposure in a Confederate prison. Mr. Higginson, after a careful and thorough investigation, summed up the case. He announced that he found the case a difficult one to handle. The beauty, brilliancy, and culture of the girl were all in her favor, but there were three strong points against her case which would be difficult to overcome: first, she was not the daughter of the man as represented; second, the man never was a Union soldier, and never was in a Confederate prison; third, the man was still living, well and hearty. He concluded to drop the case.

Now, as I understand it, the theory is that special science is the only science instruction having any considerable cultural and educational value—that it is only when the great truths of nature are thus presented that one can see the natural and physical world as a unit and in its logical order, and, finally, that it is only when one

thus studies nature that one acquires the truly scientific spirit. This theory, while beautiful, brilliant, and attractive, must also be considered in the light of some cold, hard facts when applied to adolescent minds in the early years of the high school.

First, the adolescent mind demands no such view of nature as will enable it to see either the unity of the universe or such unity of portions of the universe as presented in the typical special science. The child mind is not the mind of the philosopher. The adolescent mind demands merely an explanation—a simple, common-sense explanation—of his environment, a working explanation of the here and now.

Second, special science, as usually developed, deals chiefly with abstractions and generalizations. These are usually arrived at through type-studies. The best and most striking types are often found outside of (shall I say, rarely within?) the range of the pupil's past experience. The material placed before the student may have the semblance of concreteness but in reality it lacks concreteness because material is concrete only when it has significance and meaning in the light of past experience. No matter how concrete in form material may appear to the teacher with his more mature mind and richer experiences, if it lacks significance in the pupil's past experiences it is to him abstract and consequently lacks interest.

Third, special science has had its trial in the early years of the high school and has failed. It has, in a large measure, failed to interest the pupil; science teachers generally regard it as more or less of a failure; superintendents, school boards, and especially thinking patrons and hard-headed business men have lost faith in it and are demanding a change in science teaching as well as in other phases of high-school work. While the significance and importance of applied science in modern life have multiplied many fold, science instruction has steadily declined during the past twenty years. If the rate of decline continues at the past rate for another twenty years, science will then occupy but an insignificant place in the high-school curriculum.

We cannot much longer disregard these potent facts and cling to the theories of specialists and research enthusiasts when shaping

science courses for fourteen-year-old boys and girls just entering the high school.

GENERAL SCIENCE IS CONCRETE

Science may be organized into units having practical application and more or less utilitarian values for a basis with *exactly* the same logical sequence as when organized in accordance with purely theoretical considerations. The science involved in the production and use of light from pine knot and grease lamp of primitive times to the most modern methods of lighting may be as well organized as, and will require the same logical thinking and be of even greater educational value than, is the organization of the material usually presented under the head of light in the special science, physics.

When science is organized upon the basis of practical application and utilitarian values, only significant material is required. Our textbooks in special science today are, in a great measure, loaded down with non-significant and therefore abstract and uninteresting material introduced solely because of theoretical considerations. As a teacher of physics principally engaged in teaching students of secondary-school attainments, I assert with confidence that at least one-third of the subject-matter in the ordinary physics text may be omitted without practical loss to the average high-school student and with a positive gain in interest.

ORGANIZATION OF GENERAL SCIENCE

I repeat, the significant material of science may be organized into units of instruction presenting as much of logical order and sequence as is to be found in special science. Consider physics for a moment: There is no accepted order of topics in physics. Some texts begin with the mechanics of solids, some with a study of liquids. In some texts sound is presented early in the course; in others it comes late. In every physics text there are complete breaks in the logical sequence, as, for instance in passing from heat or sound to static electricity. Several popular texts have even divided the usually accepted units, presenting a portion of the topic early and the more difficult portions later in the course. An examination of the thirty or forty texts in physics published during

the past twenty-five years will convince any fair-minded person that there is no necessary or accepted logical sequence of topics in the subject of physics. The same lack of accepted sequence is equally evident in chemistry. About thirty years ago the order of topics in zoölogy suffered a complete reversal. Previously the higher forms of life had usually been treated first and lower forms last. Man was the first topic studied and the amoeba the last. An examination of all the texts of special science published during the past half-century would prove conclusively, I believe, that authors never have recognized and do not today recognize as necessary a certain sequence of topics in special science. Of course, within a given unit of instruction a logical sequence is observed, but history proves that special science demands neither that a certain fixed and unvarying set of topics be treated nor that those which are treated shall be studied in a fixed and unvarying order.

Now the general science advocated today violates no accepted principle of science teaching in proclaiming that there is no single set of topics which should be treated in every school and every class, and further that there is no set and unvariable order in which the topics chosen may be treated. In these respects special science never has been universalized and it is to be hoped that general science may never be universalized. Nevertheless, science to be significant and concrete must reveal to the pupil his environment in its true significance. Now there are certain phases of environment which are universal or nearly so. These phases of environment may be organized and developed into a course in science. If organized in accordance with the basic principle of revealing their utilitarian, social, and economic values, and without material reference to the theoretical considerations of special science, I believe we shall have organized a course in what progressive educators now call general science. Such an organized course will differ materially from our usual courses in special science as regards both the materials used and the mode of presentation.

A COURSE IN GENERAL SCIENCE

It is my conviction that the first year, probably the first two years, of science in the high school should be organized as general

science as interpreted above. Our plea is not for an easy, a "snap," course nor a sentimental, namby-pamby course, but rather for a course full of meaning and value, and one which will enlist the interest and demand the best effort of the pupil. It must rest upon a historical setting and reveal to the pupil something of the social and economic value of science in modern life. It must put him so far as is possible in control of his environment. It must recognize the nature of the adolescent mind and must appeal to the pupil and to his parents as worth while.

When we recognize these fundamental principles and reorganize and adapt all our high-school courses to them; when we recognize the needs of the millions of young people who will never see the inside of a college or university or even complete a high-school course; when we give up the idea that we must attempt to make profound scholars out of all the boys and girls of the generation or, failing in this, crowd them from the high school; when those in charge of our public high schools come to recognize the fact that the greatest service they can render is to make their high schools of such a character that they will attract and hold the great mass of young people till they can be trained into fairly intelligent, self-supporting, and self-respecting citizens, then and not until then may we hope to see high-school mortality lessen and science in the high school again assume the relative position which its importance in modern life justifies.

QUESTIONNAIRE ON GENERAL SCIENCE

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Sent Out June 1, 1914, to 180 Schools. Replies to June 25, 1914, from 73 Schools.

I. QUESTIONS OF FACT

1. How many years has general science been taught in your school?
   Answers: One year, 26; two, 13; three, 7; four, 3; five, 2; seven, 1; ten, 3; sixteen, 1.
2. Please state the length of the course, or courses, in months.
   Answers: Five months, 21; four, 4; eight, 2; nine, 20; ten, 13; two years, 1.
3. How many hours per week are given this subject?
   Answers: Two hours, 1; four, 7; five, 43; seven, 10.

4. In what year, or years, of the high school, or in what grades, is this work offered?

Answers: Eighth grade, 6; ninth grade, 62; tenth grade, 7.

5. Is the work elective? or required of certain students? or required of all students in some certain grade or course?

Answers: Elective, 22; required in certain courses, 13; required of all, 30.

6. Is a textbook used? If so, whose?

Answers: Texts (11 different texts used), 51; notes and outlines, 13.

7. If no textbook is used, can you send me a set of notes or an outline of the course?

Answers: Outlines received, 8.

8. Is your course based upon or built around the material of a particular special science, such as physiography, botany, physics, or physiology? If so, which science?

Answers: No, 34; physical sciences, 22; physiology, 3; biology, 1; physiography, 1.

9. What was the motive (or motives) which induced the teacher or school authories to introduce general science rather than to follow the lines of the older special sciences?

Answers: Foundation for later science, 17; school mortality, 13; to make sciences practical, 11; aid in choice, 3; special science unadapted to ninth grade, 6; failure of special science, 3; practical work, 8; shorten course, 2.

10. To what extent is your course in general science textbook work?

Answers: Largely, 27; partly, 17; little, 11.

11. To what extent is your course field work?

Answers: Some field work, 30; none, 16.

12. To what extent is your course laboratory work?

Answers: Largely laboratory work, 19; partly, 37.

13. If you have laboratory work, to what extent is it carried on as demonstration by the teacher? To what extent is it laboratory work by the student?

Answers: Mainly by teacher, 36; mainly by pupil, 33.

14. Please state any other fact of material importance regarding the course.

Answers: Replies from 24. Too varied to tabulate. Frequent statements:

1. Work regarded as successful and will be continued.
2. Increased enrolment in later sciences.
3. Disagreement regarding value of teachers' demonstrations vs. pupils' experimentations.
4. Greater attention given English than special sciences.

QUESTIONS OF OPINION

1. In your judgment, has the work in general science been a success?
Answers: Yes, 47; decidedly so, 13; doubtful, 4; no, 1; don't know, 2.

2. Has its degree of success been greater or less than might have been obtained from systematic, special science in the same grade taught by the same teacher?

Answers: Greater, 49; doubtful, 7; don't know, 1; not the question, 1; answer later, 2.

Please explain why.

Explanations, 53. Too extensive and varied to tabulate.

3. What, in your judgment, is the best reason (or reasons) for substituting general science for special science in any grade or in any year of the high school?

Answers: Replies, 66. Frequent reasons: (1) more interesting; (2) mortality in high school; (3) foundation for later work; (4) starts scientific spirit; (5) flexibility of the course; (6) not a substitute but a basis for special science; (7) adapted to adolescence; (8) shortens course for certain students; (9) offers more varied training.

4. In your opinion what material, in general, physical science material or biological material, should predominate in such a course if it is to be taught at all?

Answers: Physical science, 25; biological, 7; equal, 10; not the deciding point, 26.

Please explain why.

Explanations, 56. Too varied to tabulate.

5. What, in your judgment, should be the unifying idea or principle in a course in general science if it is to be given?

Answers: Control of environment, 29; scientific spirit, 14; foundation for later sciences, 4; unity unnecessary, 3; information, 2; scattering, 12.

6. In your judgment, should the units of instruction in general science differ materially from those in special science?

If so, in what respect should they differ?

Answers: No, 29; yes, 16; all one unit, 1; emphasis on practical units not theoretical, 1; only in degree of specialization, 1.

7. In your judgment, is general science more difficult or less difficult to teach well than special science?

Answers: More, 35; less, 14; same, 5; both, 2; depends on teacher, 5.

Please explain why.

An almost universal explanation: Makes a larger demand on the teacher, but the pupil is more interested, thus compensating.

8. From your experience, do you consider general science more or less interesting than special science in the same grade?

Answers: More, 51; less, 1; in doubt, 1; depends on teacher, 2.

How do you account for it?

Very few explanations.

9. Which do you consider more profitable for the student, general or special science?

Answers: General, 36; special, 3; depends on pupil's purpose, 9; each in its place, 10; in doubt, 5.

Why?

Explanations from 60. Nearly all agree that both are necessary.

10. The objection has been raised that general science is likely to assume a somewhat definite and unified form and be generally taught only as its content and mode of presentation are determined by textbooks which have appeared or may appear in which such courses are worked out in detail. Do you agree or disagree with this view?

Answers: Agree, 23; disagree, 14; in doubt, 13.

If the above statement is correct, and if texts in general science do appear which appeal generally to science teachers as suitable, thereby, in fact, determining the course in general science, would you regard this fact as foreboding ill for the cause of education?

No, 49; yes, 5; possibly, 4.

Why?

General agreement that same danger is confronted in most subjects.

11. In your judgment, could general science be made a success in the average school in the upper grades, say the seventh and eighth, as schools are generally conducted today?

Answers: Yes, 24; no, 35; doubtful, 7.

Please explain why.

Explanations: "It has been done in some places"; "It has proven a failure in general"; teachers are not prepared; no laboratory facilities; departmental supervision would make it possible; the six-six plan would make it possible; would crowd out necessary work in the grades.

12. Could general science be handled with as much success as special science in the first year, or first two years, of the average high school as such schools are equipped today?

Answers: Yes, 51; with adjustments, 2; only in small schools, 1; no, 7.

13. Will you kindly suggest a possible arrangement of high-school science courses including a course or some courses in general science?

Answers: Courses of study in science for the high school suggested, 41: many apparently adapted to local conditions; suggesting two years of general science, 2; suggesting that two sciences might be be taken at the same time, 1.